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# CMS Frailty Adjustment Model

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*The authors document the development of the CMS frailty adjustment model, a Medicare payment approach that adjusts payments to a Medicare managed care organization (MCO) according to the functional impairment of its community-residing enrollees. Beginning in 2004, this approach is being applied to certain organizations, such as Program of All-Inclusive Care for the Elderly (PACE), that specialize in providing care to the community-residing frail elderly. In the future, frailty adjustment could be extended to more Medicare managed care organizations.*

## INTRODUCTION

In response to the Balanced Budget Act of 1997 (BBA) requirement for health-based risk adjustment of Medicare capitation payment to health plans, in 2000 CMS implemented the Principal Inpatient Diagnostic Cost Group (PIP-DCG) model (Pope et al., 2000a). However, the PIP-DCG model was limited by its exclusive reliance on inpatient diagnoses. To fulfill the Benefits Improvement and Protection Act of 2000 (BIPA) mandate for the use of ambulatory diagnoses in risk adjustment by 2004, CMS implemented the CMS-hierarchical condition categories (HCC) model (Pope et al., 2004a). Although the PIP-DCG

and CMS-HCC methodologies are important milestones, further improvements to risk adjustment are necessary for certain Medicare subpopulations. Several analyses (Pope et al., 1998, 1999, and 2003; Gruenberg et al., 1999; Riley, 2000; Kautter and Pope, 2001; Hogan, 2001) have shown that current diagnosis-based risk adjusters do not fully predict the expenditures of the frail elderly, where frailty is generally defined in terms of functional impairments.

Accurate prediction for the frail elderly is a particularly important issue for MCOs whose models of care focus disproportionately on the frail elderly, such as PACE. The BBA mandated that Medicare capitated payments to PACE MCOs be adjusted to account for the comparative frailty of PACE enrollees. A payment factor to account for higher expenditures of the frail elderly helps ensure the viability of these frailty MCOs, and thus access for beneficiaries to the care they provide.

This article describes the development of a Medicare payment approach that adjusts payments to an MCO according to the functional impairment of its enrollees. Beginning in 2004, this approach is being applied to PACE, and to the social health maintenance organization (S/HMO), Wisconsin Partnership Program (WPP), Minnesota Senior Health Options (MSHO), and Minnesota Disability Health Options (MnDHO) demonstrations. In the future, frailty adjustment could be applied to more MCOs.

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## POTENTIAL FRAILTY ADJUSTERS

Fried and Walston (1999) provide a clinical description of frailty. Frailty represents a state of age-related physiologic vulnerability resulting from impaired reserve and a reduced capacity to respond effectively to stressors. The manifestations of frailty are a constellation of symptoms including weight loss, weakness, fatigue, inactivity, and decreased food intake. In addition, signs of frailty frequently are cited as components of the syndrome; these include decreased muscle mass, balance and gait abnormalities, deconditioning, and decreased bone mass. These clinical characteristics have been shown to be highly predictive of a range of adverse outcomes clinically associated with frailty, including decline in function, institutionalization, and mortality. In terms of disability, measures that have been used as indicators of frailty include chronic limitations or dependency in mobility, as well as activities of daily living (ADLs) or instrumental activities of daily living (IADLs). Disability is also a predictor of future risk. It is associated with increased use of physician services, hospitalizations, and mortality.

Drawing partly on this clinical description of frailty, potential frailty adjusters may be categorized as follows: (1) demographic/enrollment characteristics; (2) diagnoses; (3) service utilization; (4) functional status; (5) other self-reported or assessment health status measures; and (6) mortality rate.

### Demographic/Enrollment Factors

These characteristics include age, sex, aged versus disabled eligibility status (including originally disabled status<sup>1</sup>), Medicaid dual enrollment, and institutional

<sup>1</sup> Beneficiaries originally entitled to Medicare by disability, but currently entitled to Medicare by age, are originally disabled.

status. All of these variables are utilized in the CMS-HCC risk adjuster. Hence, these variables are not expected to be useful in explaining cost variation not captured by the CMS-HCC risk adjuster (i.e., residual expenditures).

### Diagnoses

Like included demographic variables, diagnoses included in the CMS-HCC model are not expected to be very useful for explaining residual expenditures. However, the CMS-HCC adjuster does not include all diagnoses. It is conceivable that some of the excluded diagnoses, such as dementia, could be useful in frailty adjustment. Although some further consideration of excluded diagnoses may be reasonable, we do not think they are a promising approach for frailty adjustment. First, even models with all diagnoses included (so-called profiling models) do not explain much more of expenditures associated with frailty than payment models that exclude some diagnoses (Pope et al., 1998). Second, diagnoses are excluded from the CMS-HCC and other payment models because they are vague, discretionary, variably coded, and lack clear audit criteria. That is, they are not suitable for a payment model, whether the CMS-HCC model or a frailty adjuster.

### Service Utilization

Service utilization is not included in the CMS-HCC adjuster and thus, is likely to explain some variation in residual expenditures. For example, durable medical equipment usage such as wheelchairs and supplemental oxygen is plausibly related to functional impairment and frailty and has been shown to improve expenditure prediction for the frail elderly (Pope et al., 2000b). Other types of utilization, such as

recent hospital discharge, therapy usage, enteral and parenteral nutrition, and intravenous/infusion therapy are used in case-mix adjustment systems for Medicare fee-for-service (FFS) skilled nursing facility and home health payment. The drawback of service utilization measures is that they may establish incentives for inappropriate provision of services. For example, if higher capitation rates are attached to enrollees with walkers, MCOs may have an incentive to inappropriately provide enrollees with walkers to benefit from higher payment rates.

### **Functional Status**

Functional status has utility as a frailty adjuster. It has good face validity because frailty and nursing home certifiability are often defined in terms of functional status. Functional status has been shown to explain Medicare expenditures not explained by diagnosis-based risk adjusters (Pope et al., 1998). It is relatively objective, and not obviously subject to manipulation by MCOs.

However, unlike the diagnostic and demographic information used for the CMS-HCC risk adjuster, functional status information is not currently available for all individuals enrolled in MCOs. Thus, frailty adjustment based on functional status must be derived from MCO-level surveys. MCO-level functional status estimates may be subject to non-response bias and sampling error.<sup>2</sup> However, MCO-level frailty adjustment is the only currently feasible option (Medicare Payment Advisory Commission, 2003).

<sup>2</sup>To apply frailty adjustment beginning in 2004 to PACE and the demonstrations, CMS is collecting functional status information using MCO-level surveys. The PACE Health Survey is being used for PACE and the Wisconsin and Minnesota dual-eligible demonstrations, and the Medicare Health Outcomes Survey is being used for S/HMO demonstrations.

### **Other Self-Report or Assessment Health Status Measures**

Health status indicators other than functional status may be available from self-report surveys or assessment instruments. The most prominent is self-rated global health status from surveys (“Is your health excellent, very good, good, fair, or poor?”). This variable has been shown to be related to Medicare expenditures, even after accounting for the effects of diagnoses and functional status. But self-rated health is subjective, difficult to audit, and has less face validity than functional status because it is less clear what it is measuring. For instance, there is no objective measure of global health status, and individuals may perceive their health status to be different than it really is. Two individuals with the same objective health characteristics may report their health as being different.

### **Mortality Rate**

The mortality rate is an MCO-level adjuster, not an individual adjuster. It is plausible that MCOs with higher death rates are enrolling a sicker population. The drawback of the mortality rate as a frailty adjuster is that paying MCOs more because they have a higher death rate would conflict with quality of care goals. Nevertheless, to the extent that the higher mortality of frail beneficiaries is correlated with their higher costs, it is important to examine the extent to which the CMS risk and frailty adjusters account for the higher mortality rate of MCOs such as PACE<sup>3</sup> that specialize in providing care to the frail elderly.

<sup>3</sup>PACE enrollees must be at least 55 years old, live in the PACE service area, and be certified as eligible for nursing home care by the appropriate State agency.

## Preferred Frailty Adjuster

Functional status is the most promising frailty adjuster. It has good face validity, and has been shown to explain Medicare expenditures not explained by diagnosis-based risk adjusters such as the CMS-HCC adjuster. We believe that counts of difficulty in performing ADLs is the most promising functional status measure for frailty adjustment. There are several reasons for this. First, there is substantial precedent in previous frailty adjustment research for using ADL impairments to explain Medicare expenditures not accounted for by diagnostic based risk-adjustment models (Pope et al., 1998, 1999, 2003; Gruenberg et al., 1999; Riley, 2000; Kautter and Pope, 2001; Hogan, 2001). Second, ADL impairments are often used by geriatricians to identify the frail elderly (Fried and Walston, 1999). Third, ADLs are more objective measures of functional status than IADLs, which appear to be more open to cultural influences. Fourth, our preliminary empirical analyses showed that ADL difficulties outperforms physical functioning measures (difficulty walking 2-3 blocks and lifting 10 pounds). Fifth, use of an ADL count scale improves statistical stability as compared to use of individual ADLs as frailty adjusters. Pope et al. (1998) concluded that there is only a modest decline in predictive accuracy ( $R^2$ ) from substituting scales for individual functional status measures, and the coefficients of scales are more stable than coefficients of individual measures. Finally, the use of ADLs defined by report of difficulty is preferable to the use of ADLs defined by receipt of help. We believe that it is inappropriate for a payment model to use a measure of impairment that is confounded by availability of help and the provision of care.

## APPROACH TO CALIBRATING FRAILITY ADJUSTER

The purpose of frailty adjustment is to predict the Medicare expenditures attributable to frailty that are not explained by the CMS-HCC risk adjuster. The unexplained, or residual, expenditures are defined as actual expenditures minus expenditures predicted by the CMS-HCC risk adjuster:

$$\text{Residual Expenditures} = (\text{Actual Expenditures}) - (\text{CMS-HCC Predicted Expenditures}).$$

To determine the relationship of frailty adjusters to residual expenditures, a linear regression model of the following form is estimated on a sample of beneficiaries:

$$\text{Residual Expenditures} =$$

$$\alpha_1 * (\text{frailty adjuster 1}) + \alpha_2 * (\text{frailty adjuster 2}) + \dots + \alpha_n * (\text{frailty adjuster } n) + \varepsilon,$$

where  $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$  are parameters, the frailty adjusters could be different levels of ADL limitations, and  $\varepsilon$  is a random error term. Let  $A_1, A_2, A_3, \dots, A_n$  be estimates of the parameters  $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$ . Then  $A_1, A_2, A_3, \dots, A_n$  are the predicted incremental expenditures corresponding to the frailty adjusters. A frailty factor for each frailty adjuster is derived by dividing its predicted incremental expenditures by national average per capita Medicare expenditures:

$$\text{Frailty Factor for Frailty Adjuster } k =$$

$$(\text{predicted incremental expenditures } A_k) \div (\text{national average expenditures}).$$

If the predicted incremental expenditures for frailty adjuster  $k$  (e.g., 1-2 ADL limitations) are \$600 and national average expenditures are \$6,000, then the frailty factor  $k$  for 1-2 ADL limitations would be  $\$600 \div \$6,000 = 0.100$ . National average Medicare expenditures are the divisor of the frailty factor because they are also the denominator of the CMS-HCC risk score, which consists of predicted expenditures from the CMS-HCC risk-adjustment model divided by national average expenditures. Using the same divisor allows the frailty factor to be added to the CMS-HCC risk score.

Since frailty information such as ADL limitations is collected by CMS through a mail survey, this information is available only for a subset of MCO enrollees (i.e., the respondents). Therefore, payment adjustment cannot be made at the individual level and must be made at the MCO level. The frailty scores of all respondents are used to determine an MCO average frailty score, given by:

*MCO Average Frailty Score =*

*(frailty factor 1)\*(MCO's proportion enrollees in frailty category 1) + (frailty factor 2)\*(MCO's proportion enrollees in frailty category 2) + ... + (frailty factor  $n$ )\*(MCO's proportion enrollees in frailty adjuster  $n$ ).*

The MCO-level frailty score can be calculated from a random sample of MCO enrollees that yields the proportion of MCO enrollees in each frailty category (e.g., number of ADL limitations), and the frailty factors from a previous regression calibration. To illustrate how the frailty score can be used to adjust the Medicare capitated payment for an MCO enrollee, the major elements of the MCO risk- and frailty-adjusted portion of the payment can

be represented by the following simplified payment formula:

*Risk- and Frailty-Adjusted Portion of Medicare Payment =*

*(risk adjusted county rate)\*(CMS-HCC risk score + MCO average frailty score).*

This formula illustrates that the MCO average frailty score is added to the risk score.

## MCBS ANALYTIC SAMPLE

### Prospective Sample Definition

The Medicare Current Beneficiary Survey (MCBS) data used to develop the CMS frailty adjustment model are the 1994-1997 Cost and Use Files. Each pair of consecutive years (i.e., 1994/1995, 1995/1996, and 1996/1997) is used to construct a prospective sample. The first year in a prospective sample is the base year, and the second year is the prediction year. The three 2-year prospective samples are then merged to create the 1994-1997 MCBS analytic sample. The sample size for the merged 1994-1997 MCBS data is 36,757 observations.<sup>4</sup> Of these 36,757 observations, 19,160 beneficiaries without a full set of information necessary for frailty model calibration are excluded, leaving 17,597 observations in the merged 1994-1997 MCBS analytic sample.<sup>5</sup> The most frequently excluded beneficiaries are the one-quarter who are rotated out of the MCBS sample each year and thus, lack the necessary 2 consecutive years of MCBS data. The second most frequently excluded beneficiaries are MCO enrollees, who lack

<sup>4</sup> We account for the complex sample design of the MCBS when estimating standard errors for frailty adjustment models. This will also account for the correlation of expenditures across years for a sample beneficiary present for more than 1 year.

<sup>5</sup> Because of unusable MCBS data, the number of observations when differentiating by community/long-term institutional status slightly decreases from 17,597 to 17,573.

the FFS claims data necessary to compute Medicare expenditures and CMS-HCC predicted expenditures. New enrollees who lack the 12 months of base-year data needed to compute CMS-HCC predicted expenditures, and hence residual expenditures, are also excluded.

Although a large proportion of the initial sample is excluded from the analysis, there is no reason to believe that sample exclusions create any significant bias in the results.<sup>6</sup> As one check of the representativeness of our sample, we investigated whether our MCBS sample mortality rates adjusted for functional status are typical of MCOs such as PACE. We computed a predicted mortality rate for PACE using its percentage distribution of enrollees across each ADL category, as reported in the 2001 Medicare Health Outcomes Survey, and the MCBS mortality rate for the relevant ADL category. We then compared this predicted mortality rate for PACE to the 2001 actual mortality rate for PACE, derived from the Medicare enrollment database. The mean actual PACE mortality rate is 15.7 percent, and the mean predicted mortality rate is 14.2 percent, which is very similar. This supports the validity of using the MCBS to calibrate a frailty payment adjuster for PACE.

## **Analytic Variables**

### **Residual Expenditures**

Residual Medicare expenditures are defined as the difference between actual expenditures and expenditures predicted by the CMS-HCC model. Actual Medicare expenditures for each beneficiary in the prediction year are calculated by summing the Medicare expenditures associated with Medicare-covered services provided to the

individual, including inpatient, skilled nursing facility, hospital outpatient, physician, home health, and durable medical equipment services. To develop correct average monthly Medicare expenditures for all beneficiaries, including those who die, we use a process of annualizing expenditures and weighting observations (Ellis et al., 1996).

### **ADLs**

We create a scale based on the number of ADL difficulties, i.e., 5-6, 3-4, 1-2, and no difficulties (for beneficiaries responding “doesn’t do the ADL,” we impute “difficulty”). Because the frailty adjuster is prospective, we use counts of ADL difficulties in the base year. MCBS functional status survey data, including data on ADL difficulties, are collected in the fall of the base year.

### **Long-Term Institutional Status**

We use the Facility Event File in the MCBS to create the prediction year long-term institutional status variable. We follow the definition used for the CMS-HCC risk-adjustment model, which was developed separately for the community and long-term institutionalized Medicare subpopulations. Once a beneficiary has 90 consecutive days in a nursing home, then he/she enters long-term institutional status.

### **Percentage Distributions by Counts of ADL Difficulties**

Table 1 shows percentage distributions of beneficiary characteristics and of the frailty adjuster, counts of ADL difficulties, for the 1994-1997 MCBS analytic sample. The row percentages show that large numbers of ADL impairments are most common among long-term institutionalized

<sup>6</sup> Kautter and Pope (2001) provide detailed reasons for sample exclusions and further information on file construction.

**Table 1**  
**Percentage Distributions<sup>1</sup> by Counts of Activities of Daily Living (ADLs) Difficulties and Beneficiary Characteristics**

Characteristic	Row Percentages					Column Percentages				
	ADL 5-6	ADL 3-4	ADL 1-2	ADL 0	Total	ADL 5-6	ADL 3-4	ADL 1-2	ADL 0	Total
<b>Total</b>	7.5	7.3	18.8	66.4	100	100	100	100	100	100
<b>Age</b>										
0-64 Years	8.8	10.7	27.6	52.8	100	13.3	16.5	16.6	9.0	11.3
65-74 Years	3.2	4.0	13.7	79.1	100	19.0	24.4	32.4	52.9	44.4
75-84 Years	6.9	8.1	20.3	64.7	100	30.4	36.7	35.5	32.1	33.0
85+ Years	24.6	14.4	25.9	35.1	100	37.3	22.5	15.6	6.0	11.4
<b>Sex</b>										
Female	8.9	8.6	20.0	62.6	100	69.1	68.5	61.6	54.8	58.1
Male	5.5	5.5	17.3	71.7	100	30.9	31.5	38.4	45.2	41.9
<b>Originally Disabled<sup>2</sup></b>										
Yes	13.0	13.0	27.8	46.2	100	12.3	13.1	10.8	4.7	6.9
No	6.9	6.4	17.0	69.7	100	87.7	86.9	89.2	95.3	93.1
<b>Medicaid</b>										
Yes	17.5	12.2	23.8	46.5	100	37.4	26.7	20.3	11.2	16.0
No	5.6	6.4	17.9	70.2	100	62.6	73.3	79.7	88.8	84.0
<b>Community/Long-Term Institutional Status<sup>3</sup></b>										
Community-Residing	4.6	6.7	19.0	69.6	100	59.0	87.8	95.9	99.5	95.0
Long-Term Institutionalized	60.4	17.7	15.2	6.7	100	41.0	12.2	4.1	0.5	5.0
<b>Mortality</b>										
Survivor	6.2	7.0	18.6	68.2	100	78.4	91.1	93.6	97.5	94.8
Decedent	31.3	12.6	23.4	32.6	100	21.6	8.9	6.4	2.5	5.2

<sup>1</sup> Percentages are weighted by the MCBS cross-sectional survey weight.

<sup>2</sup> Beneficiaries originally entitled to Medicare by disability, but currently entitled to Medicare by age are originally disabled. Originally disabled status is only meaningful for beneficiaries age 65 or over.

<sup>3</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence. For community/long-term institutional status, percentages are weighted by the product of the MCBS cross-sectional weight and the fraction of Medicare eligible months in community/long-term institutional status. For the merged 1994-1997 MCBS analytic sample, 94.3 percent of beneficiaries are full-time community-residents, 4.5 percent are full-time long-term institutional residents, and 1.2 percent have a mixture of community and long-term institutional residence.

NOTES: Age, originally disabled, community/long-term institutional status, and mortality are measured in the prediction year, all other variables are measured in the base year. MCBS is Medicare Current Beneficiary Survey.

SOURCE: Kauter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

**Table 2**  
**Preliminary Frailty Adjustment Model<sup>1</sup>**

Independent Variable <sup>2</sup>	Parameter	Observations <sup>3</sup>	Estimate	Standard Error <sup>4</sup>	T-Value	P-Value
ADLs 5-6	P1	1,317	\$2,630	684	3.84	0.000
ADLs 3-4	P2	1,284	1,307	413	3.17	0.002
ADLs 1-2	P3	3,312	839	318	2.64	0.008
ADLs 0	P4	11,684	-671	94	-7.14	0.000

**Joint F-Test**

P1 = P2 = P3 = P4 = 0: *F*-Value = 23.29; *P*-Value = 0.000.

<sup>1</sup> In the preliminary frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) survey weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> ADLs measured in the base year.

<sup>3</sup> Weighted by MCBS survey weights.

<sup>4</sup> Adjusted for the MCBS complex sample design.

NOTES: *N*=17,597. *R*<sup>2</sup> is 0.63 percent. ADLs is activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

beneficiaries, those who died in the prediction year, beneficiaries age 85 or over, Medicaid enrollees, and aged beneficiaries originally entitled by disability. Interestingly, over one-half (53 percent) of beneficiaries currently entitled by disability (age 0-64) report no ADL limitations. The column percentages show that two-thirds of the most impaired beneficiaries (5-6 ADL limitations) are age 75 or over, and nearly 70 percent are female. However, over one-half of the most impaired beneficiaries reside in the community, most are not on Medicaid, and over three-quarters survive the entire prediction year.

## FRAILTY ADJUSTMENT MODEL DEVELOPMENT

In this section we document the development of the CMS frailty adjustment model. Residual expenditures, i.e., actual minus CMS-HCC-predicted expenditures, are regressed on counts of difficulties in performing ADLs (5-6, 3-4, 1-2, 0) to estimate mean residual expenditures associated with each ADL category. We explore differences among Medicare subpopulations in the relationship between residual expen-

ditures and counts of ADL difficulties. Because of limited MCBS sample sizes and the added complexity of subgroup variations, we focus on identifying subpopulations, if any, whose mean residual expenditures differ substantially from the overall Medicare population. We use statistical methods to test for differences in residual expenditures among subpopulations. However, we do not follow a mechanical statistical hypothesis-testing approach to subpopulation differences. Rather, in addition we consider the practical and policy significance of subpopulation differences, whether they can be accurately estimated with available sample sizes, and the added complexity of making more distinctions.

## Preliminary Frailty Adjustment Model

Table 2 shows our preliminary frailty adjustment model in which residual expenditures are regressed on counts of ADL difficulties. Residual expenditures steadily rise as counts of ADL difficulties increase. The CMS-HCC model underpredicts Medicare expenditures by an average of \$2,630, \$1,307, and \$839 for, respectively, beneficiaries with 5-6, 3-4, and 1-2 ADL



**Table 3**  
**Preliminary Frailty Adjustment Model<sup>1</sup>, by Community/Long-Term Institutional Status**

Independent Variable <sup>2</sup>	Parameter	Observations <sup>3</sup>	Estimate	Standard Error <sup>4</sup>	T-Value	P-Value
<b>Community<sup>5</sup></b>						
ADLs 5-6	P1	771	\$4,935	874	5.64	0.000
ADLs 3-4	P2	1,125	1,533	423	3.63	0.000
ADLs 1-2	P3	3,171	805	329	2.44	0.015
ADLs 0	P4	11,619	-702	92	-7.62	0.000
<b>Long-Term Institutional<sup>5</sup></b>						
ADLs 5-6	P5	535	-870	808	-1.08	0.282
ADLs 3-4	P6	157	-354	1,206	-0.29	0.769
ADLs 1-2	P7	135	1,684	1,693	0.99	0.320
ADLs 0	P8	59	5,355	2,203	2.43	0.015

**Joint F-Tests**

(1) P1 = P5, P2 = P6, P3 = P7, P4 = P8: F-Value = 10.98; P-Value = 0.000.

(2) P1 = P2 = P3 = P4 = 0: F-Value = 30.39; P-Value = 0.000.

(3) P5 = P6 = P7 = P8 = 0: F-Value = 2.87; P-Value = 0.022.

<sup>1</sup> In the preliminary frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> ADLs measured in the base year.

<sup>3</sup> Weighted by MCBS survey weights.

<sup>4</sup> Adjusted for the MCBS complex sample design.

<sup>5</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N= 17,573.  $R^2$  is 1.04 percent. ADLs are activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

difficulties, and among beneficiaries with no ADL difficulties, the CMS-HCC model overpredicts Medicare expenditures by \$671. Each of these regression coefficient estimates is statistically significantly different from zero at the 5-percent level.

The  $R^2$  for the regression is 0.63 percent, which is consistent with what previous research has found ADLs add to a claims-based diagnosis model such as the CMS-HCC model (Pope et al., 1998).<sup>7</sup> Although the percentage of individual variation that is explained by ADLs is low, important systematic differences in average expenditures by ADL groups exist. Thus, if MCOs enroll disproportionately more or fewer beneficiaries with ADL difficulties, they will be inaccurately paid absent frailty adjustment.

<sup>7</sup>The  $R^2$  for the CMS-HCC risk adjustment model is 9.97 percent (Pope et al. 2004b), so ADLs add about 7 percent to its explanatory power.

## Community/Long-Term Institutional Status

Table 3 shows the preliminary frailty adjustment model by community/long-term institutional status. The  $R^2$  is 1.04 percent. Accounting for differences between the two groups of beneficiaries thus raises the percentage of variation explained in residual expenditures from 0.63 to 1.04 percent, a gain of 65 percent, indicating that this is an important distinction to make.

The regression coefficient estimates by ADL difficulties for community beneficiaries are markedly different than for the long-term institutionalized. Although the joint hypothesis test that the regression coefficient estimates for the long-term institutionalized are all equal to zero is rejected at the 5-percent level (Table 3), only one of the four long-term institutional ADL coefficients is significantly different

**Table 4**  
**Base Frailty Adjustment Model<sup>1</sup>**

Independent Variable <sup>2</sup>	Parameter	Observations <sup>3</sup>	Estimate	Standard Error <sup>4</sup>	T-Value	P-Value
<b>Community<sup>5</sup></b>						
ADLs 5-6	P1	771	\$4,923	874	5.63	0.000
ADLs 3-4	P2	1,125	1,531	423	3.62	0.000
ADLs 1-2	P3	3,171	809	329	2.46	0.014
ADLs 0	P4	11,619	-697	93	-7.53	0.000
Long-Term Institutional <sup>5</sup>	P5	886	10	682	0.01	0.988

**Joint F-Test**

P1 = P2 = P3 = P4 = 0: F-Value = 30.06; P-Value = 0.000.

<sup>1</sup> In the base frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> ADLs measured in the base year.

<sup>3</sup> Weighted by MCBS survey weights.

<sup>4</sup> Adjusted for the MCBS complex sample design.

<sup>5</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N= 17,573. R<sup>2</sup> is 0.96 percent. ADLs is activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

than zero. The small zero ADL group, which has significant positive residual expenditures, could comprise beneficiaries who were healthy in the base year when ADLs and diagnoses for CMS-HCC risk scores are measured, but then become acutely ill, expensive, and long-term institutionalized in the prediction year. Since no special adjustment is made in prospective risk adjustment for other beneficiaries who become acutely ill in the prediction year, it is not clear that any payment adjustment for them is warranted. Therefore, we determined that the appropriate frailty adjuster for the long-term institutionalized is zero regardless of the level of functional impairment. In essence, long-term institutionalization is itself an indicator of frailty and no additional adjustment based on functional limitations appears needed.

By separating the long-term institutionalized from the community sample, the estimate of residual expenditures for the most impaired community-residing beneficiaries rises sharply, from \$2,630 (Table 2) to \$4,935 (Table 3). (Estimates of residual

expenditures for other ADL levels do not differ substantially between the community sample and the overall sample.) Therefore, a frailty payment adjustment that accounts for community/long-term institutional status directs substantially more resources to MCOs enrolling the community-residing frail elderly, and keeping them in the community, out of nursing homes.

### Base Frailty Adjustment Model

Based on our results for the two groups, we specify a base frailty adjustment model in which residual expenditures are regressed on counts of ADL difficulties for community beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by number of ADL impairments. Table 4 presents the base frailty adjustment model, which is used to explore differences in residual expenditures among community beneficiary subgroups. Among community beneficiaries with 5-6, 3-4, and 1-2 ADL difficulties,

the CMS-HCC model underpredicts Medicare expenditures, respectively, by an average of \$4,923, \$1,531, and \$809, and for no ADL difficulties, overpredicts by \$697. Each of these regression coefficient estimates is statistically significantly different from zero at the 5-percent level. Residual expenditures for long-term institutionalized beneficiaries are essentially zero, which is expected because long-term institutional status is accounted for in the CMS-HCC model. The  $R^2$  for the regression is 0.96 percent, only slightly less than when long-term institutionalized beneficiaries are distinguished by counts of ADL impairments (Table 3). Note that MCOs will receive the substantial additional payments for enrolling the frail elderly only as long as they keep them out of nursing homes. This financial incentive to avoid long-term institutionalization may have positive spillover effects by reducing Medicaid and private nursing home expenditures, and partially offsets the often noted institutional bias in health care payments for the frail elderly.<sup>8</sup>

## Community Subpopulations

We use the base frailty adjustment model (Table 4) to explore differences in residual expenditures for community subpopulations defined by age categories, sex, Medicaid status, and originally disabled status. On average, the CMS-HCC model predicts expenditures accurately for these subpopulations, but expenditures within category may differ by functional impairment. In addition, we examine whether residual expenditures differ substantially by the level of the CMS-HCC risk score.

<sup>8</sup>In addition, by distinguishing between community versus long-term institutional status, the diagnosis-based CMS-HCC model generally raises Medicare payments for community beneficiaries relative to long-term institutionalized beneficiaries with the same diagnostic profile.

## Age Categories

Table 5 presents the base frailty adjustment model by age category. The  $R^2$  is 1.11 percent, which is moderately higher (16 percent) than for the base model (0.96 percent). The regression coefficient estimates for beneficiaries age 65 or over are each statistically significantly different from zero at the 5-percent level. For beneficiaries age 55-64, the estimates are jointly statistically significantly different from zero at the 5-percent level. These results imply that frailty adjustment is necessary for beneficiaries age 65 or over and age 55-64. However, the regression coefficient estimates for age 0-54 are not statistically significantly different from zero, either individually or jointly. Lack of significance does not appear to be primarily due to low MCBS sample sizes: there are over 1,000 observations total for this age range, and 700 for the no ADL difficulties category. These findings for the age 0-54 group do not support an additional payment adjustment for frailty, and thus the frailty factor for the age 0-54 group is zero.

It is not surprising that residual expenditure patterns are more similar to the elderly among beneficiaries age 55-64 than among beneficiaries age 0-54. Because beneficiaries age 55-64 are nearing elderly status, they are more likely to have the same types of age-related physical impairments as do elderly beneficiaries. The joint hypothesis test that residual expenditures by ADL count for age 55-64 are equal to those for age 0-54 is rejected at the 5-percent statistical significance level. Although low sample sizes for beneficiaries age 55-64 make it difficult to obtain stable coefficient estimates for this group, the point estimates for the age 65 or over and age 55-64 groups exhibit a roughly similar pattern, and the joint hypothesis test that the regression coefficient estimates for age 65

**Table 5**  
**Base Frailty Adjustment Model<sup>1</sup>, by Age Categories<sup>2</sup>**

Independent Variable <sup>3</sup>	Parameter	Observations <sup>4</sup>	Estimate	Standard Error <sup>5</sup>	T-Value	P-Value
<b>Community<sup>6</sup> and Age 65 or Over</b>						
ADLs 5-6	P1	621	\$5,859	1,002	5.85	0.000
ADLs 3-4	P2	921	1,648	501	3.29	0.001
ADLs 1-2	P3	2,637	723	362	2.00	0.046
ADLs 0	P4	10,578	-717	99	-7.26	0.000
<b>Community and Age 55-64</b>						
ADLs 5-6	P5	56	3,056	2,791	1.10	0.274
ADLs 3-4	P6	85	2,766	1,824	1.52	0.130
ADLs 1-2	P7	255	2,481	1,714	1.45	0.148
ADLs 0	P8	342	-1,171	380	-3.08	0.002
<b>Community and Age 0-54</b>						
ADLs 5-6	P9	95	563	835	0.67	0.500
ADLs 3-4	P10	119	-192	701	-0.27	0.784
ADLs 1-2	P11	279	96	364	0.26	0.793
ADLs 0	P12	700	-163	279	-0.58	0.559
Long-Term Institutional <sup>6</sup>	P13	886	-2	682	0.00	0.998
<b>Joint F-Tests</b>						
(1) P1 = P5, P2 = P6, P3 = P7, P4 = P8: F-Value = 0.89; P-Value = 0.4698.						
(2) P1 = P9, P2 = P10, P3 = P11, P4 = P12: F-Value = 7.28; P-Value = 0.000.						
(3) P5 = P9, P6 = P10, P7 = P11, P8 = P12: F-Value = 2.41; P-Value = 0.048.						
(4) P1 = P2 = P3 = P4 = 0: F-Value = 28.84; P-Value = 0.000.						
(5) P5 = P6 = P7 = P8 = 0: F-Value = 4.12; P-Value = 0.003.						
(6) P9 = P10 = P11 = P12 = 0: F-Value = 0.28; P-Value = 0.891.						

<sup>1</sup> In the base frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> Age is measured as of February 1 of the prediction year.

<sup>3</sup> ADLs measured in the base year.

<sup>4</sup> Weighted by MCBS survey weights.

<sup>5</sup> Adjusted for the MCBS complex sample design.

<sup>6</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N=17,573. R<sup>2</sup> is 1.11 percent. ADLs are activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

or over are equal to those for age 55-64 cannot be rejected at the 5-percent statistical significance level. The estimated coefficients for age 65 or over and age 55-64 can be reasonably combined to obtain more stable coefficient estimates.

## Sex

As shown in Table 6, the joint hypothesis test that the regression coefficient estimates for males and females are equal cannot be rejected at the 5-percent level. Although there is some difference in residual expenditures patterns by counts of

ADL difficulties between male and female beneficiaries (males have higher residual expenditures), differences are not substantial (the R<sup>2</sup> rises by only 6 percent compared to the base model), and we therefore do not recommend the added complexity of distinguishing between males and females in the frailty adjustment model.

## Medicaid Status

Table 7 presents mean residual expenditures for the base frailty adjustment model by prior-year Medicaid status. The R<sup>2</sup> is 1.01 percent, which is only 5-percent higher

**Table 6**  
**Base Frailty Adjustment Model<sup>1</sup>, by Sex**

Independent Variable <sup>2</sup>	Parameter	Observations <sup>3</sup>	Estimate	Standard Error <sup>4</sup>	T-Value	P-Value
<b>Community<sup>5</sup> and Female</b>						
ADLs 5-6	P1	508	\$4,582	1,025	4.47	0.000
ADLs 3-4	P2	761	1,146	521	2.20	0.028
ADLs 1-2	P3	1,950	511	350	1.46	0.145
ADLs 0	P4	6,361	-891	103	-8.69	0.000
<b>Community and Male</b>						
ADLs 5-6	P5	264	5,586	1,272	4.39	0.000
ADLs 3-4	P6	364	2,351	749	3.14	0.002
ADLs 1-2	P7	1,221	1,289	608	2.12	0.034
ADLs 0	P8	5,258	-460	154	-2.99	0.003
Long-Term Institutional <sup>5</sup>	P9	886	14	682	0.02	0.984

**Joint F-Tests**

(1) P1 = P5, P2 = P6, P3 = P7, P4 = P8: F-Value = 2.36; P-Value = 0.052.

(2) P1 = P2 = P3 = P4 = 0: F-Value = 26.97; P-Value = 0.000.

(3) P5 = P6 = P7 = P8 = 0: F-Value 10.59; P-Value = 0.000.

<sup>1</sup> In the base frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> ADLs measured in the base year.

<sup>3</sup> Weighted by MCBS survey weights.

<sup>4</sup> Adjusted for the MCBS complex sample design.

<sup>5</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N= 17,573. R<sup>2</sup> is 1.02 percent. ADLs are activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

than the  $R^2$  for the base frailty adjustment model (0.96 percent). The equality of regression coefficient estimates for Medicaid and non-Medicaid is rejected at the 5-percent level of significance. However, for beneficiaries who are community and Medicaid, the residual expenditures associated with 3-4 ADLs are lower than the residual expenditures associated with 1-2 ADLs, which lacks face validity. Furthermore, the residual expenditures for 1-2 and 3-4 ADLs are not statistically different from zero. Finally, the Medicaid and non-Medicaid estimates by ADL level are broadly similar, except for the anomalously low value for Medicaid, 3-4 ADLs, which could be due to a small sample size. We therefore do not incorporate Medicaid status into the frailty adjuster.

## Originally Disabled Status

Beneficiaries originally entitled to Medicare by disability, but currently entitled by age, are originally disabled. Originally disabled is only defined for beneficiaries age 65 or over. Table 8 presents the base frailty adjustment model by originally disabled status. The age 0-64 subpopulation currently entitled by disability is included for completeness, but differences in residual expenditures by age were previously discussed. The joint hypothesis test that the regression coefficient estimates are equal for the two age 65 or over subpopulations defined by originally disabled status cannot be rejected at the 5-percent significance level. We conclude that originally disabled status should not be incorporated into the frailty adjustment model.

**Table 7**  
**Base Frailty Adjustment Model<sup>1</sup>, by Medicaid Status<sup>2</sup>**

Independent Variable <sup>3</sup>	Parameter	Observations <sup>4</sup>	Estimate	Standard Error <sup>5</sup>	T-Value	P-Value
<b>Community<sup>6</sup> and Medicaid</b>						
ADLs 5-6	P1	202	\$3,692	1,200	3.08	0.002
ADLs 3-4	P2	270	97	630	0.15	0.877
ADLs 1-2	P3	600	518	554	0.94	0.350
ADLs 0	P4	1,279	-1,130	256	-4.41	0.000
<b>Community and Not Medicaid</b>						
ADLs 5-6	P5	570	5,361	1,031	5.20	0.000
ADLs 3-4	P6	856	1,991	505	3.94	0.000
ADLs 1-2	P7	2,571	878	376	2.33	0.020
ADLs 0	P8	10,340	-643	103	-6.26	0.000
Long-Term Institutional <sup>6</sup>	P9	886	12	683	0.02	0.986

**Joint F-Tests**

(1) P1 = P5, P2 = P6, P3 = P7, P4 = P8: F-Value = 2.60; P-Value = 0.035.

(2) P1 = P2 = P3 = P4 = 0: F-Value = 7.55; P-Value = 0.000.

(3) P5 = P6 = P7 = P8 = 0: F-Value 21.39; P-Value = 0.000.

<sup>1</sup> In the base frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> Medicaid status measured in the base year.

<sup>3</sup> ADLs measured in the base year.

<sup>4</sup> Weighted by MCBS survey weights.

<sup>5</sup> Adjusted for the MCBS complex sample design.

<sup>6</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N=17,573. R<sup>2</sup> is 1.01 percent. ADLs is activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

## CMS-HCC Risk Score

Frailty adjustment is incremental to the CMS-HCC risk adjuster. However, residual expenditures could differ by the level of the CMS-HCC risk score. For example, residual expenditures could be greater for beneficiaries with high risk scores if there is a positive interaction between diagnosis-based risk and functional-status-based risk. Alternatively, for a given level of functional impairment, residual expenditures might be lower for higher risk score beneficiaries if diagnoses explain more of the greater expenditures for these beneficiaries. Hypotheses about the relationship of residual expenditures to risk scores can be tested by interacting the CMS-HCC risk scores with the ADL categories and including the interaction terms in the base frailty adjustment model regression.

As shown in Table 9, for beneficiaries with 5-6 ADL difficulties, residual expenditures appear to be positively correlated with the CMS-HCC risk score, indicating that beneficiaries with both 5-6 ADL difficulties and high CMS-HCC risk scores are particularly expensive. However, none of the ADL/risk score interaction coefficients, including the coefficient for 5-6 ADLs and the risk score, are individually statistically different from zero at the 5-percent level of significance. Moreover, the joint hypothesis that the ADL by risk score interaction terms are all equal to zero cannot be rejected at the 5-percent level. Further, the R<sup>2</sup> of 1.08 percent, 13 percent higher than for the base frailty adjustment model (0.96 percent), is not an especially large increase in the percentage of explained variation in residual expenditures. Finally,

**Table 8**  
**Base Frailty Adjustment Model<sup>1</sup>, by Originally Disabled Status<sup>2</sup>**

Independent Variable <sup>3</sup>	Parameter	Observations <sup>4</sup>	Estimate	Standard Error <sup>5</sup>	T-Value	P-Value
<b>Community,<sup>6</sup> Originally Disabled, and Age 65 or Over</b>						
ADLs 5-6	P1	84	\$5,956	2,614	2.28	0.023
ADLs 3-4	P2	124	1,357	1,182	1.15	0.251
ADLs 1-2	P3	281	-82	954	-0.09	0.932
ADLs 0	P4	492	-1,698	559	-3.04	0.002
<b>Community, Not Originally Disabled, and Age 65 or Over</b>						
ADLs 5-6	P5	537	5,737	1,071	5.36	0.000
ADLs 3-4	P6	797	1,523	502	3.03	0.003
ADLs 1-2	P7	2,355	775	375	2.07	0.039
ADLs 0	P8	10,085	-683	103	-6.60	0.000
<b>Community and Age 0-64</b>						
ADLs 5-6	P9	150	1,463	1,105	1.32	0.186
ADLs 3-4	P10	204	1,024	835	1.23	0.220
ADLs 1-2	P11	534	1,224	828	1.48	0.140
ADLs 0	P12	1,041	-477	218	-2.19	0.029
Long-Term Institutional <sup>6</sup>	P13	886	46	686	0.07	0.947
<b>Joint F-Tests</b>						
(1) P1 = P5, P2 = P6, P3 = P7, P4 = P8: F-Value = 0.980; P-Value = 0.417.						
(2) P1 = P9, P2 = P10, P3 = P11, P4 = P12: F-Value = 1.85; P-Value = 0.117.						
(3) P5 = P9, P6 = P10, P7 = P11, P8 = P12: F-Value = 2.67; P-Value = 0.031.						
(4) P1 = P2 = P3 = P4 = 0: F-Value = 3.48; P-Value = 0.008.						
(5) P5 = P6 = P7 = P8 = 0: F-Value = 22.57; P-Value = 0.000.						
(6) P9 = P10 = P11 = P12 = 0: F-Value = 2.99; P-Value = 0.019.						

<sup>1</sup> In the base frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> Measured as of February 1 of the prediction year. Beneficiaries originally entitled to Medicare by disability, but currently entitled to Medicare by age are originally disabled. Originally disabled status is only meaningful for beneficiaries age 65 or over.

<sup>3</sup> ADLs measured in the base year.

<sup>4</sup> Weighted by MCBS survey weights.

<sup>5</sup> Adjusted for the MCBS complex sample design.

<sup>6</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N=17,573. R<sup>2</sup> is 1.04 percent. ADLs is activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

incorporation of the CMS-HCC risk score in the frailty adjustment model would require MCO-level estimates of average CMS-HCC risk scores by ADL category, which may be subject to nonresponse bias and sampling error. For these reasons we do not recommend incorporation of interactive effects of the CMS-HCC risk score in the frailty adjustment model at the present time.

## CMS Frailty Adjustment Model

Table 10 presents the CMS frailty adjustment model. The R<sup>2</sup> is 1.06 percent. The R<sup>2</sup> for the CMS-HCC model is 9.97 percent (Pope et al. 2004b), so the frailty adjuster adds about 11 percent to its explanatory power. For community beneficiaries age 55 or over, residual expenditures are \$5,609, \$1,744, \$880, and -\$731 for, respectively, counts of ADL difficulties 5-6, 3-4, 1-2, and

**Table 9**  
**Base Frailty Adjustment Model<sup>1</sup>, by CMS-HCC Risk Score<sup>2</sup>**

Independent Variable <sup>3</sup>	Parameter	Observations <sup>4</sup>	Estimate	Standard Error <sup>5</sup>	T-Value	P-Value
<b>Community<sup>6</sup></b>						
ADLs 5-6	P1	771	\$2,418	1,476	1.64	0.102
ADLs 3-4	P2	1,125	2,083	669	3.11	0.002
ADLs 1-2	P3	3,171	779	571	1.37	0.172
ADLs 0	P4	11,619	-487	298	-1.63	0.103
Risk Score*ADLs 5-6	P5	—	1,301	828	1.57	0.117
Risk Score*ADLs 3-4	P6	—	-368	472	-0.78	0.436
Risk Score*ADLs 1-2	P7	—	24	551	0.04	0.965
Risk Score*ADLs 0	P8	—	-244	390	-0.63	0.532
Long-Term Institutional <sup>6</sup>	P9	886	11	682	0.02	0.988

**Joint F-Tests**

(1) P1 = P2 = P3 = P4 = 0: F-Value = 4.29; P-Value = 0.002.

(2) P5 = P6 = P7 = P8 = 0: F-Value = 1.34; P-Value = 0.255.

<sup>1</sup> In the base frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing beneficiaries, and long-term institutionalized beneficiaries are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> Equals predicted expenditures from the CMS-hierarchical condition categories risk-adjustment model divided by mean Medicare national expenditures.

<sup>3</sup> ADLs measured in the base year.

<sup>4</sup> Weighted by MCBS survey weights.

<sup>5</sup> Adjusted for the MCBS complex sample design.

<sup>6</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

NOTES: N=17,573. R<sup>2</sup> is 1.08 percent. ADLs are activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

0. Each of these regression estimates is statistically significantly different from zero at the 5 percent level. The regression coefficient estimate for community beneficiaries age 0-54 is -\$48, and for the long-term institutionalized the regression estimate is -\$1. Since the estimates are not statistically significantly different from zero for these two groups, their frailty factors are set to zero.

For community beneficiaries age 55 or over, the frailty factor for each count of ADL difficulty is defined as the regression coefficient estimate for that count divided by mean national FFS Medicare expenditures for the 1999/2000 Medicare sample used to calibrate the CMS-HCC risk adjuster, which equals \$5,129. Frailty factors are 1.094, 0.340, 0.172, and -0.143 for, respectively, counts of ADL difficulties 5-6, 3-4, 1-2, and 0. Hypothetically, if the proportions of a random sample of MCO enrollees reporting 5-6, 3-4, 1-2, and 0 ADL limita-

tions were, respectively, 40, 30, 20, and 10 percent, and all enrollees were community-residing,<sup>9</sup> the MCO average frailty score would be 0.560. If the average CMS-HCC risk score for the MCO were 1.800, the risk-adjusted rate is increased by about one-third (from 1.800 to 1.800+0.560=2.360) to account for the above average frailty of MCO enrollees. This example shows that frailty adjustment can substantially raise Medicare payments to MCOs enrolling large proportions of community-residing, functionally impaired beneficiaries.

## CONCLUSIONS

Current diagnosis-based risk adjustment does not fully predict expenditures for the community-residing frail elderly. Absent frailty adjustment, MCOs enrolling disproportionate numbers of frail beneficiaries

<sup>9</sup> In addition, we assume all beneficiaries enrolled in the MCO are age 55 or over, and reside in a single county.



**Table 10**  
**CMS Frailty Adjustment Model<sup>1</sup>**

Independent Variable <sup>2</sup>	Observations <sup>3</sup>	Estimate	Standard Error <sup>4</sup>	T-Value	P-Value	Frailty Factor <sup>5</sup>
<b>Community<sup>6</sup> and Age<sup>7</sup> 55 or Over</b>						
ADLs 5-6	677	\$5,609	990	5.66	0.000	1.094
ADLs 3-4	1,006	1,744	470	3.71	0.000	0.340
ADLs 1-2	2,892	880	358	2.46	0.014	0.172
ADLs 0	10,919	-731	98	-7.45	0.000	-0.143
Community and Age 0-54	1,193	-48	242	-0.20	0.843	0.000
Long-Term Institutional <sup>6</sup>	886	-1	682	0.00	0.999	0.000

<sup>1</sup> In the CMS frailty adjustment model, residual expenditures are regressed on counts of ADL difficulties for community-residing, age 55 or over beneficiaries. Community-residing, age 0-54 beneficiaries, and long-term institutionalized beneficiaries, are identified, but not distinguished by counts of ADL difficulties. Regression is weighted by the product of the Medicare Current Beneficiary Survey (MCBS) weight and the fraction of the prediction year alive and eligible for Medicare by age or disability.

<sup>2</sup> ADLs measured in the base year.

<sup>3</sup> Weighted by MCBS survey weights.

<sup>4</sup> Adjusted for the MCBS complex sample design.

<sup>5</sup> Equals the regression estimate divided by mean expenditures for the 1999/2000 Medicare 5 percent prospective modeling sample used to calibrate the CMS-hierarchical condition categories model, which equals \$5,129. Frailty factor equals zero for regression estimates not statistically significantly different from zero.

<sup>6</sup> Measured in the prediction year and can be a fractional variable, reflecting a mixture of community and long-term institutional residence.

<sup>7</sup> Age is measured as of February 1 of the prediction year.

NOTES: N=17,573. R<sup>2</sup> is 1.06 percent. ADLs is activities of daily living. Dependent variable is residual expenditures (expenditures not explained by the CMS-hierarchical condition categories model).

SOURCE: Kautter, J. and Pope, G.C.: Data from the 1994-1997 MCBS Cost and Use Files.

residing in the community would be underpaid. This article documented the development of the CMS frailty adjustment model, a Medicare payment approach that pays an MCO according to the functional impairment of its community-residing enrollees.

In 2004 CMS began phasing in this frailty adjustment approach for PACE and the S/HMO, WPP, and MSHO/MnDHO demonstrations. This was an important milestone for Medicare frailty adjustment. The frailty adjuster, in addition to improving the accuracy of payments under risk adjustment, transformed payments to these organizations that specialize in providing care to the community-residing frail elderly. For a portion of the payment, the previous global program multipliers (e.g., 2.39 for the entire PACE program) or status indicators defined differently across states (e.g., nursing home certifiability) are replaced by the CMS-HCC risk adjuster based on the specific diagnoses of each enrollee, and the functional status frailty adjuster specific to each MCO's

enrollees. This current approach provides more accurate payments to each PACE and demonstration plan for the average sickness and frailty of its enrollees. Moreover, paying MCOs more for frail beneficiaries only when they are residing in the community encourages MCOs to avoid long-term institutionalization.

CMS is considering future expansion of frailty adjustment to more MCOs. Making frailty-adjusted payments regardless of MCO type would encourage all MCOs to enroll frail beneficiaries, to innovate in their care (Medicare Payment Advisory Commission, 1999), and to care for them in the community rather than in institutions. There are, however, several concerns regarding expanding the application of frailty adjustment. First, whereas risk adjustment was developed on over a million observations, the frailty adjuster was calibrated on far fewer observations. Although it is not necessary to collect functional impairment information for a million observations because the frailty adjuster

has relatively few payment categories, the frailty payment weights would be more stable and reliable if the frailty model was calibrated using more observations. Second, the frailty adjuster was calibrated on FFS functional impairment data collected via an in-person survey. However, it is applied to the payments based on MCO functional impairment data collected via a mail survey. Differences in survey responses due to the mode of administration is a concern (Dillman and Christian, forthcoming, 2005), and an additional adjustment to control for these differences might be needed before frailty adjustment could be expanded. Alternatively, FFS functional impairment data could be collected via a mail survey and used to recalibrate the frailty adjuster. Third, the county capitation ratebook has not been restandardized for frailty adjustment because functional impairment data are not generally available for the Medicare population. It is not yet known whether the ratebook would need to be restandardized for frailty, and if so, in which counties and by how much. These issues would need to be addressed in order to expand frailty adjustment to other MCOs.

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